WRIGHT-PATTERSON AIR FORCE BASE, AREA B,
BUILDING 20, SUPER SONIC TEST LABORATORY
DAYTON VIC.
GREENE COUNTY
OHIO

HAER No. OH-79-BC

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PHOTOGRAPHS

WRITTEN HISTORICAL AND DESCRIPTIVE DATA

Historic American Engineering Record
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HISTORIC AMERICAN ENGINEERING RECORD

WRIGHT-PATTERSON AIR FORCE BASE, AREA B,
BUILDING 26, SUPER SONIC TEST LABORATORY
HAER No. OH-79-BC

Location: Wright-Patterson Air Force Base, Area B, Dayton Vicinity, Greene County, Ohio.

Dates of Construction: 1943-45.

Present Owner: USAF.

Present Use: Super Sonic Test Laboratory.

Significance: Building 26, the Super Sonic Test Laboratory, was built during Wright Field's World War II expansion. Throughout its history it has housed the latest equipment capable of simulating subsonic, transonic or supersonic speeds. Research essential to post-World War II aircraft development has been conducted here.

Project History: This report is part of the overall Wright-Patterson Air Force Base, Area B documentation project conducted by HAER 1991-1993. See overview report, HAER No. OH-79, for a complete description of the project.

DESCRIPTION: Building 26 sits in the northeast corner of the wind tunnel complex, and, although it is largely obscured by additions, tanks, fences and pipes, it is consistent in style with the other buildings in the vicinity. The three-story, split level, reinforced-concrete building has a flat roof with a wood cornice and frieze band, a penthouse, and irregular wings. The two-story west end has a parapeted roof front and four upper level window bays. The roof underside and the control room inside have been acoustically treated.

HISTORY: In September of 1943, construction began on Building 26, the new Supersonic Testing Laboratory. By 1950, the Two Foot Supersonic Wind Tunnel was operational, with the Six-Inch Supersonic Wind Tunnel following a year later.

Two-Foot Trisonic Gasdynamics Facility

The "trisonic" in this wind tunnel's name refers to its capability to operate at subsonic, transonic, and supersonic speeds. The tunnel operated for two decades as the Supersonic Gasdynamics Facility, capable of only supersonic and relatively inefficient subsonic testing. In the early 1970s, however, a 15" transonic section was designed to fill the transonic void left by the conversion of the Ten-Foot Wind Tunnel to the 50 Megawatt Facility.

For subsonic testing, this closed circuit, variable density wind tunnel generates airflow at mach speeds from 0.23 to 0.85. With the transonic insert in place, airflow through mach 1 can be attained. For supersonic testing, different sets of nozzles are inserted for discrete mach numbers of 1.5, 1.9, 2.3, and 3.0. In the early 1960s the tunnel's compressor could be connected in series with the Ten-Foot Wind Tunnel's old scavenging pumps in Building 25D, which gave the tunnel a mach 5 capability. However, that configuration produced an airflow with a Reynolds Number too low for practical applications. (Reynolds Number is the ratio represented by dividing the product of the density of the fluid and the velocity of the fluid and the linear dimension of the body in the fluid by the kinematic coefficient of viscosity of the fluid. Thus, as the size of the model decreases, the density of the fluid must increase proportionally for the test to accurately illustrate the aerodynamic properties of the full scale model in flight. This becomes an especially critical factor for high speed tunnels, as they usually have very small test sections and therefore are limited to very small scale models.)

Powered by a 3500-horsepower induction motor and a 5000-horsepower AC synchronous motor, the ten stage, axial flow compressor features unique variable vanes. The stagnation section

contains a honeycomb and screen arrangement to minimize turbulence. This section also maintains the airflow's temperature at 100°F (±1°) with a water-cooled heat exchanger. Model support for the tunnel is a rack-mounted 50" radius crescent, equipped with a variety of sting extensions. The test section is equipped with Schlieren quality windows. The tunnel's optical instrumentation includes excellent Schlieren and laser light sheet capabilities, spherical and parabolic mirrors, optical benches, light sources, cameras, and an interferometer. A Jarrel Ash 3.4 meter grating spectrograph was transferred to Building 254 in the early 1960s. Consuming eight million watts per hour, the Trisonic Gasdynamics Facility's continuous run-time makes it preferable to many other high temperature, high speed tunnels. Throughout its 40 years of operation, the tunnel has contributed to many advanced aircraft and missile projects. High angle of attack studies are popular in the tunnel, which can simulate angles up to 48°. For example, numerous nozzle designs for the X-29 nose tip have been tested in the facility. The nozzles, which improve high angle of attack and tight turning capabilities, are also being considered for use on several of the advanced fighters currently in service (F-15, F-16 and F18). Along with the X-29, numerous other hypersonic glide vehicles (some of which are not expected to be in production until 2010 and beyond) have been tested in the Trisonic Gasdynamics Facility. Some other designs recently analyzed in the tunnel include submerged inlets for aircraft and missiles, a Canadian delta wing model, and ICBM nose tips capable of penetrating 50' of concrete.

Six-Inch Supersonic Wind Tunnel

Built in 1949, the Six-Inch Supersonic Wind Tunnel facility conducted aerodynamic testing on models in the supersonic range by 1951. Powered by one 1,000-horsepower variable-frequency motor, the variable-density, closed-return wind tunnel had mach capabilities to 2.5, with a test section measuring 6" x 6" x 12". However, by the mid 1950s the tunnel, though not officially closed, was no longer being used. With no foreseeable use, the Air Force donated the Six-Inch Wind Tunnel to Ohio State University in 1958.

For bibliography, see Wright-Patterson Air Force Base overview report (OH-79-BC).

Two Foot Trisonic Gasdynamics Facility

Type:		Closed circuit, variable density, continuous flow
Overall Size:		71'3" x 27'
Centerline Circuit Length:		160'
Model Type:		3 dimensional
Test Section:		Closed throat, rectangular, 2' x 2', 4' long
Max. Diameter:		9'
Contraction Ratio:		16:1
Velocity:	Subsonic:	mach 0.23 - 0.85
	Transonic:	through mach 1
	Supersonic:	discrete mach no. 1.5, 1.9, 2.3, 3.0
Max. Dynamic Pressure:		
	Subsonic:	350 psf
	Transonic:	1400 psf
	Supersonic:	600 - 1000 psf
Total Pressure:		0-4000 psf (normal range: 1100-2800 psf)
Max. Reynolds Number/Foot:		
	Subsonic:	2.5 million
	Transonic:	8 million
	Supersonic:	3 - 5 million
Power:		3500 hp induction motor, 5000 hp AC synchronous motor
Temp. Control:		Water cooled (calcium chloride brine heat exchanger)
Operating Temp. & Press. Range:		Tunnel stagnation temperature maintained at 100°F ±1°, stagnation pressure maintained to within ±1 psf of any pressure within range
Air Drive:		Allis Chalmers 10-stage, axial flow compressor
Drive Shaft:		10' long.

Max. Fan rpm:	3490
Model Support System:	Rack mounted 50" radius crescent with position displayed on operator's console with any accuracy to 0.01°F, pitch range from -1°F to +18.5°F (-1° to +12°F for transonic section)